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Reposting "Till Albert Einstein Is TikTok Famous": The Memetic Construction of Science on TikTok

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Since its launch in 2018, TikTok has become one of the fastest growing social media applications in the world, being particularly popular among young people. Memetic videos, which often feature lip-syncing, dance routines, and comedic skits, are a defining feature of the platform. This study used quantitative content analysis and qualitative thematic analysis to examine science memes, an increasingly popular genre of memes on TikTok, by analyzing 1,368 TikTok videos that feature science-related content. The results of the study uncover the most influential science-content creators, the most prevalent content in science memes, and three vernacular styles of science memes on TikTok. The results expand the existing science-communication scholarship focusing on the context of social media. Understanding the role of memetic science content on short-video platforms, as well as in the youth digital culture in general, also provides valuable insights into how science communicators can better engage with members of the young generation.

Keywords: TikTok, science communication, memes, youth digital culture, short videos

"Boom Bababom Pow" is one of the many viral soundtracks on TikTok; by April 2020, it had been used in over 445,000 videos on the platform. One of these videos features Albert Einstein writing his famous E = mc2 equation on a blackboard. The video has been viewed over 1 million times, and one user wrote in his caption that he would be reposting it "till Albert Einstein is TikTok famous."

The phrase *TikTok famous* describes individuals or themes featured in viral content on TikTok. Since its launch in 2018, TikTok has become a popular and rapidly growing social media application (app) around the world. As one the most downloaded apps worldwide since 2019, TikTok, together with its Chinese sister-app Douyin, had accumulated over 1 billion monthly active users in early 2020 (Pham, 2020). In comparison with other popular social media platforms, one distinguishing characteristic of TikTok is its young

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user base. More than two thirds of active TikTokers are under the age of 30 (Price, 2019). For its users, TikTok has become a widely used source of information on popular culture as well as on other issues, and even news (Newman, Fletcher, Schultz, Andi, & Nielsen, 2020).

As a social media platform catering to teenagers, TikTok champions virality and encourages memetic remixes. Short meme videos, between 15 and 60 seconds, have become a defining feature of the platform. While TikTok is mostly famous for memetic videos featuring lip-syncing, dance routines, and comedy skits, the platform has also experienced an increase in science-related content since 2019 (Hayes, Stott, Lamb, & Hurst, 2020; Roumeliotis, Yang, Wang, & Alper, 2019). As of April 2020, the #scienceiscool and #scienceismagic hashtags have accumulated 4 billion views on the platform. From chemistry experiments to fun facts, science-themed content is being turned into memes. Recently, TikTok has also collaborated with scientists to launch #scienceathome and #learnonTikTok to promote the platform's educational impacts (Thoensen, 2020).

The current study investigates the role of science memes on TikTok and their potential role in science communication. In the context of digital culture, memes are multimodal online artifacts that are circulated through imitation, competition, and transformation (Ask & Abidin, 2018; Milner, 2013; Shifman, 2013). In this study, we define *science memes* as digital content featuring "science" that is widely imitated and reiterated by Internet users. We take a nonessentialist, constructivist view of "science": We do not presuppose a homogeneous, ex ante definition of *what science is or should be*. Instead, we are concerned with *how science is (re)presented and imagined* on TikTok. Methodologically, this means that we inductively explore memes that have been tagged or described as "science" by their creators. Accordingly, the current exploratory study examines the representation of viral science content on TikTok, the characteristics of science-meme creators, and the entwinement of science with vernacular styles afforded by the platform.

Conceptual Framework

Video Sharing as Science Communication

Social media has great potential for science communication (Brossard, 2013; Davies & Hara 2017; Huber, Barndige, & Gil de Zúñiga, 2019; Peters, Dunwoody, Allgaier, Lo, & Brossard, 2014), and particularly so when it comes to reaching out to young people (Hargittai, Füchslin, & Schäfer, 2018). Because of its popularity and multimodality, video-sharing platforms are perceived as, at least in principle, an ideal locale for communicating science (Allgaier, 2018; León & Bourk, 2018; Metag, 2020).

Audiovisual content allows for using and combining several ways of displaying, explaining, and visualizing scientific ideas, findings, and concepts, ranging from images, animations, and specific cinematographic techniques (such as time-lapse, slow motion, or night vision) to the use of different languages, subtitles, and data sonification. Luzon (2019) claimed that "online science videos are multimodal texts which draw on several modes or semiotic resources (e.g., non-verbal sound, spoken and written language, images) to re-contextualize scientific discourse" (p. 170). This re-contextualization can be used, for instance, to bridge the knowledge gaps between scientific experts and the general public (Erviti &

Stengler, 2016; Luzon, 2019), but also to allow new actors, such as YouTubers, to participate in public science communication (Reif, Kneisel, Schäfer, & Taddicken, 2020).

Despite the great potential and complexity of online videos for science communication, the existing literature on science communication largely focuses on legacy media's presentation of science (M. S. Schäfer, 2012). Only a few studies have focused on videos, and for the most part, those studies exclusively focused on YouTube (Allgaier, 2019). To bridge this gap, our study investigated public science communication on TikTok, an emerging short-video platform.

Established Models of Science Communication

Traditional public science communication has been theorized and presented using three conceptual models: the deficit model, the public engagement model, and the marketplace model (Bucchi, 2008; Dahinden, 2004; Fähnrich, 2017; M. S. Schäfer & Metag, in press).

In the deficit model, scientists play the role of educators, possessing an allegedly superior knowledge that they then "translate" in a simplified way to their audience (M. S. Schäfer & Metag, in press). Apart from disseminating scientific results, science practitioners also present "science in the making," that is, of the scientific process and its characteristics (Shapin, 1992). Scientific organizations often apply communication adhering to this model using YouTube channels and online videos primarily as one-way channels to disseminate scientific content (Allgaier, 2020; Erviti & Stengler, 2016; Welbourne & Grant, 2016).

The second model, public engagement, emphasizes a more "egalitarian" (Weingart, 2005) and two-way communication between science and society. This model is particularly relevant to the nonorganizational science YouTuber's approach to communicating science. Prior studies of science-themed videos on YouTube have shown that professional organizations contribute to more science-related content than amateur science YouTubers do, but the content produced by the latter is more popular (Morcillo, Czurda, Geipel, & Robertson-von Trotha, 2019; Welbourne & Grant, 2016). According to previous research, the factors contributing to "amateur" YouTubers' success include their "know-how" in engaging with audiences (Erviti & Stengler, 2016), using dialogic communication styles and parasocial interactions (Rihl & Wegener, 2019), and presenting themselves as credible (Reif et al., 2020).

The third model, the marketplace model, focuses on the "often contentious and politicized debates that tend to surround communication about science in the real world" (Akin & Scheufele, 2017, p. 27). This model is most relevant for scientific issues that are often controversial. In the case of science communication on video-sharing sites, this model can be exemplified by scientists' and vloggers' expressing their opinions on controversial science issues (Erviti, Codina, & León, 2020). Under this communication model, prior research on YouTube has shown that scientists and other experts are often not perceived as credible, whereas unverified information is often better received (e.g., Allgaier, 2019; Venkatraman, Garg, & Kumar, 2015).

These three models are helpful for identifying certain elements of short-video presentations of science, and they will be used for that purpose in our study. However, science communication on TikTok, with its many particularities and novel dynamics, does not lend itself easily to the three models. Thus, it is necessary to introduce a second conceptual framework.

Vernacular Creativity and Science Memes

The concept of vernacular creativity (Burgess, 2006) can serve as an effective heuristic device to capture these peculiarities and dynamics, that is, to understand how science communication is shaped, and even reinvented, by meme creation on TikTok.

The term *vernacular* refers to nonofficial and noninstitutional everyday speech. Vernacular creativity can be defined as new media-empowered productive articulation of communicative practices and their amalgamation with older popular traditions (Burgess, 2006). In more recent social media research, vernacular creativity has been further applied to study the local specificity of creative expressions and folklores, both textual and imaginary (De Seta, 2018; Gibbs, Meese, Arnold, Nansen, & Carter, 2015; Pearce et al., 2020). While both Burgess's (2006) original theorization and its recent application focus on cultural production, in our study, we extended this concept to research knowledge production in the context of video memes on TikTok.

First, the concept of vernacular creativity provides the theoretical language necessary for addressing the epistemological authority of science in popular culture. The premise of the vernacular is a form of expression that opposes the institutional/authoritative voice and, thus, a mode of science communication that has long been prominent in the communication of scientific organizations (Metag & Schäfer, 2017; Welbourne & Grant, 2016). Rather than focusing on how lay people challenge the elite and institutional authorities, the concept of vernacular creativity requires researchers to focus on the factors that allow mundane practices to "redraw *boundaries* between amateurs and professionals" (Burgess, 2006, p. 205) to become part of culture/knowledge production. In the context of science, the boundaries between amateurs and professionals describe the rhetorical boundary-work between science and nonscience, which has long served as an essential resource for constructing a space for "science" in the pursuit of epistemological authority (Gieryn, 1999).

However, in the information society, this form of boundary work has become blurred and challenged (Kohlenberger, 2015). On the one hand, the democratizing power of new media facilitates the representation of the lay public in science practice and knowledge production (Füchslin, Schäfer, & Metag, 2019; T. Schäfer & Kieslinger, 2016). On the other hand, scientific institutions infiltrate popular culture for legitimization (Kohlenberger, 2015).

To study the extent to which the epistemological authority of science is democratized on TikTok, we first sought to determine what forms of content are presented as "science" and by whom, which leads to our first two research questions (RQs):

RQ1: How is "science" presented in science memes on TikTok?

RQ2: Who are the creators of science memes?

In her original work, Burgess (2006) introduced vernacular creativity in the context of digital storytelling. As she pointed out, young storytellers possess a unique set of vernacular creativity as manifested in their skill to effectively relay everyday experiences into the shared public culture (Burgess, 2006). On TikTok, a platform dominated by Gen-Z creators, vernacular creativity is manifested by its users' technical savviness (employing sonic and visual elements, editing, using filters) and cultural literacy in the youths' in-jokes and coded visual grammar.

For science practitioners and communicators to successfully engage with the younger generation, they need to acquire knowledge about and understand the younger generation's vernacular creativity. Studies have noted that science faces the challenge of approaching young people (Spiegel, McQuillan, Halpin, Matuk, & Diamond, 2013; Weigold & Treise, 2004), and most science institutions poorly use digital platforms to engage with youth (e.g., Welbourne & Grant, 2016). Focusing on science memes, we examined how science can be effectively communicated in the vernacular styles of TikTok. In relation to the third research question, we examined the vernacular styles of science memes—that is, the visual idioms and meme elements in a popular science content.

RQ3: What are the distinctive vernacular styles of science memes on TikTok?

Methodology

Identifying Science Memes

The term *memes* is often used loosely or indiscriminately in scholarship to refer to information that is remixable, which was described by Shifman (2013) as an "inclusive memetic approach" (p. 367). However, this conceptual fuzziness and inclusiveness can undermine the concept's analytical power. In this study, we introduce a set of defining characteristics that allow us to systematically identify science memes. As previously discussed, we define *science memes* as *digital content featuring (or claiming to be) "science" that is imitated and reiterated by a large number of Internet users*. Based on this working definition, science memes need to meet the following three criteria: science-relatedness, popularity, and imitation.

First, to determine the *science-relatedness* of the videos, we did not use predetermined criteria to define what science is. Because we wanted to explore how "science" is presented on TikTok, we focused on TikTok videos that are presented as "science." Therefore, we used the platform's online archive to retrieve publicly available videos tagged as "science" (Figure 1). A Web crawler was used to obtain metadata on all of those types of videos in the archive, returning 3,091 videos published between August 2018 and November 2019.

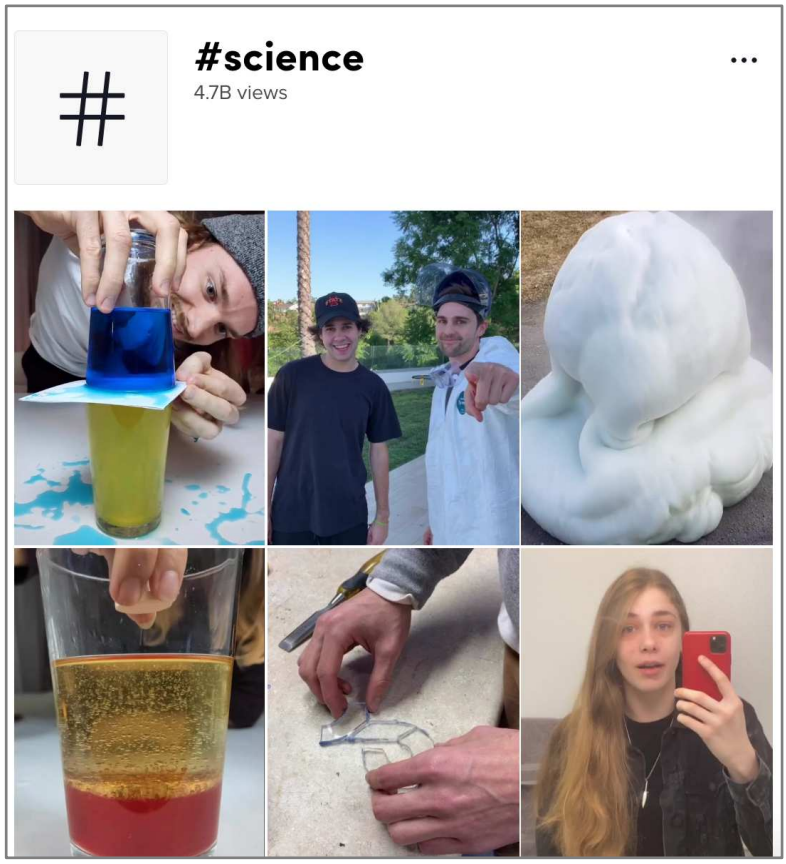

Figure 1. Screenshot of the Web archive of #science.

Second, the *popularity* of individual videos in this data set was measured via likes and shares. We used the average (median) of likes and shares as the threshold for selecting popular content, and we excluded less popular videos from our sample.

Third, we identified *imitated content* using two approaches. Popular TikTok content can be directly recreated by either making a *duet* (recording a new video on a split screen, with the new responding video placed next to the original one) or by reusing the same background sound. Figure 2 demonstrates two examples of this "traceable meme re-creation." The first picture shows a list of memetic "soap and pepper" experiments that were created with the same background narrative. The second picture shows videos responding to the Institute of Human Anatomy's demonstration of a piece of human skin through TikTok's duet function. Using this method, 1,012 memetic videos were identified.

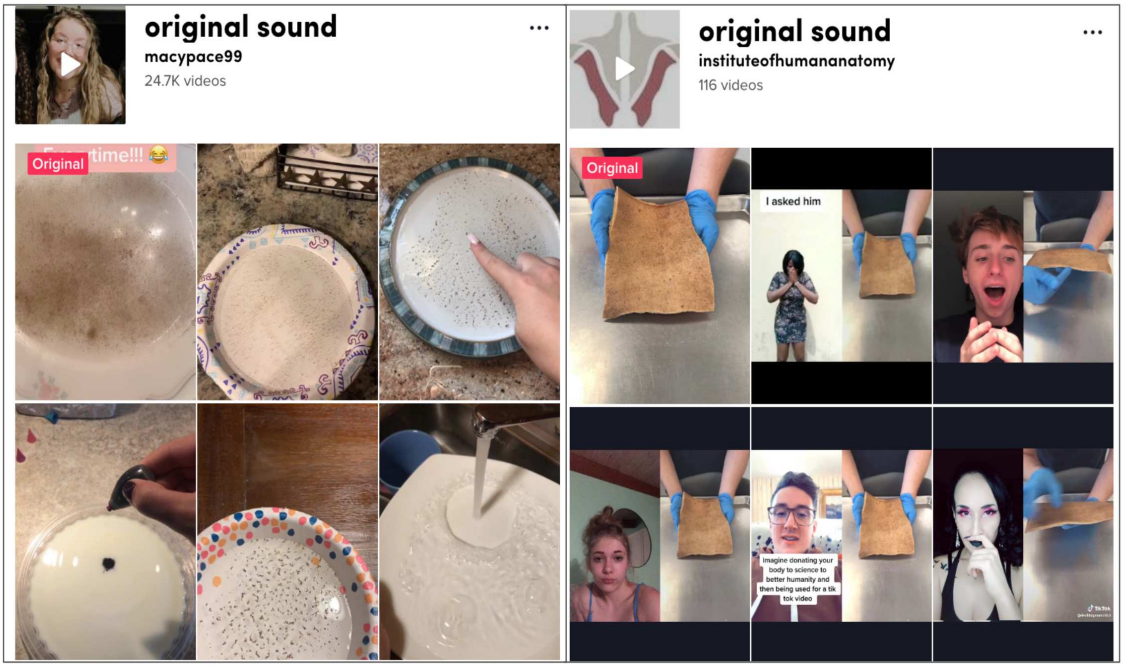

Figure 2. Two forms of the "traceable re-creation" of science memes.

Because TikTokers can also recreate videos without directly making a duet or using the original sound, one supplementary step was taken to identify "false negative" science memes. Identifying those types of memes requires a robust grasp of TikTok trends in general. Therefore, one expert—who closely followed and studied TikTok for 12 months before the study—went through popular videos that were not marked as a "meme" in the previous step. Based on that expert's insight of overall trends of the platform, an additional 356 science meme videos were identified.

Using the steps just discussed, 1,368 videos, produced by 726 unique accounts, were selected as science memes for further analysis.

Mixed-Methods Approach to Investigating Science Memes

To identify who the "TikTok scientists" are, a trained research assistant categorized all 726 profiles into four general groups: science-themed individual accounts, science-themed organizational accounts, science-themed aggregator accounts, and other, nonscience-themed accounts. The second coder double-coded a 20% random sample (N = 145). Intercoding reliability was .89, as calculated with Cohen's kappa. Using metadata collected from each video (likes, views, and shares), we then compared the activity and engagement metrics.

To categorize and measure the different forms of content in science memes on TikTok (RQ1), we employed a combination of qualitative and standardized content analysis and studied a sample of 200

randomly selected videos. Based on Shifman's (2013) framework of meme dimensions, we systematically annotated the sampled TikTok videos on four levels: science discipline, content, form, and communication function. Except for science discipline, for which we adopted the categories from Morillo, Bordons, and Gómez (2003),[1] the first author developed code categories relevant to science memes using a two-step process following the aggregation and interpretation rules of qualitative content analysis (e.g., Mayring & Fenzl, 2019). In the first step, open coding was deployed to inductively label 100 videos across all four dimensions. In the second step, all the annotation labels were organized into higher categories based on their similarities and interrelations, using qualitative strategies, such as paraphrasing. For instance, content presenting "objects in science museums," "self-made science gadgets," and "science toys" were organized under the broader category of "technoscience objects." Through this process, we developed a detailed codebook for standardized content analyses, with explanations and example videos; a research assistant used these to code all 200 videos quantitatively (details available in Table 1). Except for the coded scientific discipline, the categories in the other three dimensions are non–mutually exclusive; thus, more than one value can be assigned. The intercoding reliability (Cohen's kappa) between the two coders for each dimension was .87, .81, .82, and .79, respectively.[2]

Table 1. Content Analysis Results From Manual Coding.

Category	Explanation	Percentage
Science Discipline		
Physics	Videos presenting experiments or concepts related to physics, including astronomy	.34
Chemistry	Videos presenting experiments or concepts related to chemistry, such as a video clip of experiments of a chemical reaction	.21
Biology/Agriculture/Environmental Sciences	Videos presenting experiments or concepts related to biology/agriculture/environmental sciences	.09
Engineering/Technology	Videos featuring gadgets or concepts related to engineering or technology	.04
Social and Behavioral Science	Videos featuring science content related to social or behavioral science disciplines, such as anthropology and psychology.	.03
Medicine	Videos covering medical and health-related content	.02
Science in general	Videos talking about "science" in general, without specifying a discipline	.13

[1] Agriculture/Biology/Environmental Sciences, Biomedicine, Clinical Medicine, Chemistry, Engineering/ Technology, Humanities, Mathematics, Physics, and Social Sciences.

[2] When assessing the interrater reliability of categories that are non–mutually exclusive, two coders are considered having reached an agreement once their annotations have one shared value under a specific coding dimension.

Other	Videos featuring a discipline that either does not belong to the other categories or is unclear	.15
Content		
Science in making	Videos showing the process of doing experiments or do-it-yourself (DIY) things in the name of science	.57
Facts, concepts, phenomena explained	Videos of an individual presenting facts or explaining a science phenomenon	.21
Techno-science objects	Videos showing science-related gadgets or big equipment, which can be self-made, purchased or from a museum	.12
Being science students/teachers/scientists	Videos showing the "behind the scenes" life of being a science teacher or a researcher; videos of science students in school reflecting on their experience of studying science	.09
Nature	Videos with animals or plants as the main objects, which are often presented with time-lapse or slow motion	.04
Unclear	Videos featuring content not from any of the aforementioned categories, or videos that no longer exist	.12
Form		
Demonstrating	Recording the procedure of an experiment, a science equipment, plants, or animals	.71
Plain speaking	Videos presenting one person standing in front of a camera explaining things	.15
Performing	Videos featuring dance routines, lip-synching	.11
Duet	Videos made with the duet function	.05
Other	Videos formatted in a way that is not listed earlier, or videos that no longer exist	.06
Communicative Function		
Entertaining	Videos that show surprising or shocking outcomes, or humorous elements	.62
Educational	Videos featuring a explicitly educational aspect, which the audience can use to acquire knowledge	.37
Visually satisfying	Videos emphasizing the visuality and aesthetics of the content	.10
Other	Videos that do not present any of the previously mentioned characteristics or that no longer exist	.15

To identify the most prevalent vernacular styles, the selected videos from our data set were then again interpreted, synthesized, and contextualized qualitatively. Employing purposive sampling, the first author closely examined 100 videos with the most engagements to extract higher level patterns of their

visual idioms and meme elements—that is, their vernacular styles. This process followed the six-step procedure proposed by Braun and Clarke (2013), and it was recorded as field notes. Because of the limitations of intercoder reliability for assessing the rigor of qualitative sense-making and abstract pattern extraction procedures (Braun & Clarke, 2013; Krippendorff, 2004; Loffe & Yardley, 2004), our examination of the vernacular style of science memes did not implement an intercoder reliability check. Instead, the rigor of our findings was ensured through in-depth engagement with the topic and the three authors' detailed collaborative interpretation of the data (Yardley, 2008).

Results

How Is "Science" Presented in Science Memes on TikTok?

We assessed, as a first content characteristic, which scientific disciplines were present in the science memes on TikTok. Table 2 shows the most prominent disciplines among the 200 manually coded videos. Of those videos, 55% featured physics and chemistry (N = 109), mostly experiments or chemical reactions. Biology was represented in 9% of the 200 videos, often featuring animals and plant life. Social and behavioral sciences only appeared in 3% of the videos, mostly as discussions of facts from psychology. Around 13% of the videos discussed "science" in general, without indicating a specific discipline.

Table 2. Summary of the Engagement Metrics of the Four Creator Groups.

	Video count	Shares		Comments		Likes	
		Median	IQR	Median	IQR	Median	IQR
Nonscience themed	838	108	636	64	226	8,869	35,272
Science Aggregator	403	13	52	9	28	1,941	7,120
Science Organization	77	162	2,258	113	1,026	35,277	140,793
Science Personal	281	111	666	75	299	8,078	89,274

For the second content characteristic we analyzed which aspect(s) of science were featured. More than half of the science memes (59%) present "science in the making"—that is, visualizations and/or explanations of (steps of) the research process. Another 21% of the videos fall into the "explanation" category, which refers to content used to explain scientific concepts. We found that 12% of the videos were made to show a specific science-related object, such as science toys (e.g., magnetic slime and magic sand) or gadgets exhibited in science museums. Not all the science memes are about delivering scientific and educational content. About 10% of the videos in the sample presented what it was like to be a scientist, science teacher, or science student. Such "behind-the-scenes" videos often humorously reveal the challenges and sometimes frustrations associated with these roles.

Third, regarding the presentation style of the videos, the vast majority (85%) used "demonstration" (of experiments, gadgets, or animals) or "plain speaking." Over 10% of the videos' format was labeled as "performance," by which we mean videos featuring dance routines, lip-syncing, or comedy skits. This category of science memes may be considered the most typical "TikTok-native" content; it is often multimodal, with a trendy soundtrack in the background and text stickers in the foreground. One interesting practice of "performing" science is to explain science concepts using "role-playing" skits. For instance,

TikTokers perform chemical reactions through *anthropomorphism* (Wood, 2019), thus attributing human characteristics to chemical substances and directing a mini drama between them. In the first video shown in Figure 3, the science-content creator @lab_shenanigans role-played mitotic spindle fibers and chromosomes having a fight as a way to explain the relationship between these biochemistry concepts. In the second example, the biology student @cooneytoons demonstrated the process of osmosis by performing water leaving the cell through the membrane while lip-syncing to the trendy soundtrack "Cry for Me" with the lyrics "you will never see me again."

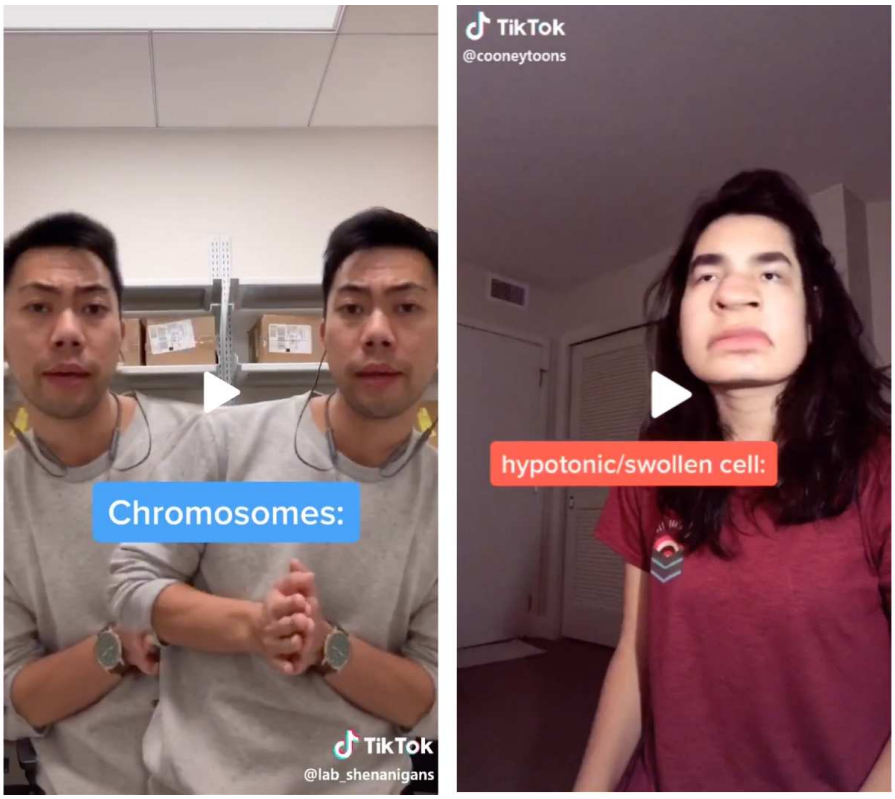

Figure 3. Examples of TikTokers "performing science."

Fourth, we assessed the communicative function of the science memes as intended by their creators. The most prominent function was "entertaining"; 62% of the videos belonged to this category. According to our definition, entertaining videos show surprising or shocking outcomes or present humorous elements. Around 32% of the videos were labeled "educational"; scientific knowledge was explicitly delivered in the video. Although all the videos in our data set were labeled as "science," most of them were not created solely for educational purposes. As mentioned, the communicative function categories assigned to a video are non–mutually exclusive. By examining the co-occurrence of communication functions, we found that over half of educational content (51%) was also labeled as entertaining. For example, one of the most frequently recurring themes in our science meme videos was the Coke and Mentos Challenge, with TikTokers regularly making "eruptions of Diet Coke" by putting Mentos mints in a bottle of Diet Coke (Figure 4). This

experiment has been widely used for either pranking others or self-pranking, but the scientific aspect of the physical reaction is rarely explained. About 10% of the videos were labeled as "visually satisfying content." These videos emphasized the visuality and aesthetics of a science experiment or science objects.

Figure 4. Example of the Coke and Mentos challenge.

Who Are the Science Meme Creators?

The science-meme videos in our data set originated from 726 unique user accounts. Only 64 of these accounts were science-themed profiles. These accounts made up only 8.8% of all the profiles we studied, but they produced 36.7% (*N* = 503) of all the science memes.

In our content analysis, we distinguished the types of science-themed accounts. The science-themed individual accounts (*N* = 46) included accounts by science teachers, science students, and researchers. Teachers and students often taught or demonstrated scientific experiments using TikTok. For instance, high school chemistry teacher Phil Cook (@chemteacherphil) had one of the most popular science accounts in our data set (Figure 5). By May 2020, Cook's videos demonstrating chemistry experiments had accumulated more than 22 million likes and 2 million followers since his TikTok debut in late 2019.

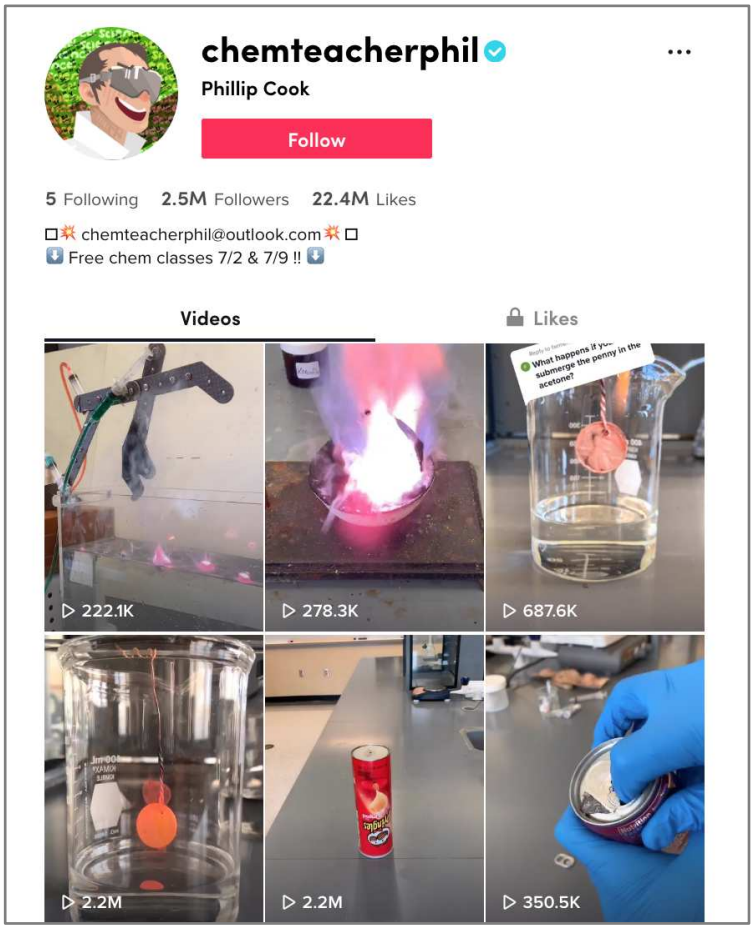

Figure 5. High school chemistry teacher Phil Cook.

Another influential account was Nick Uhas (@nickuhas), known for his outdoor experiments. Uhas's record-breaking elephant toothpaste experiment has received more than 265 million views on TikTok (as of May 2020), making it the most viewed video in our data set (Figure 6). Different from Phil Cook, Nick Uhas was an established science-focused vlogger on YouTube and a TV celebrity before debuting on TikTok. His pre-TikTok fame contributed to his popularity on TikTok (7.2 million followers and 90 million likes).

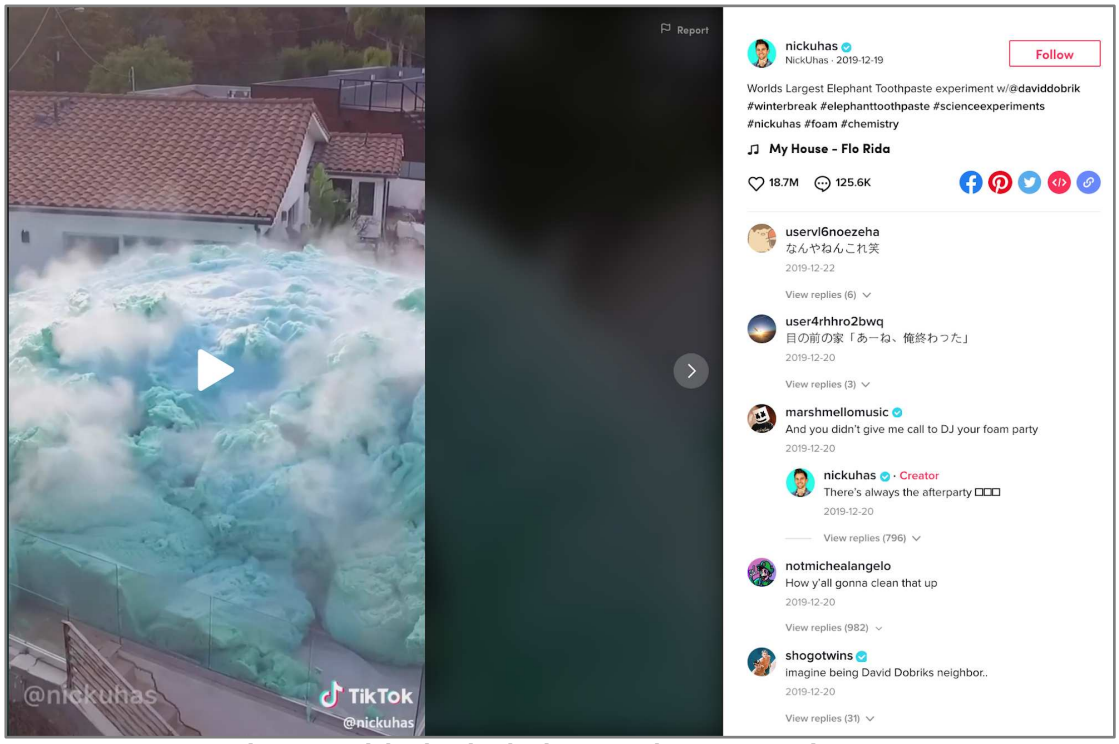

Figure 6. Nick Uhas's elephant toothpaste experiment.

The science-themed organizational accounts (*N* = 11) are predominantly set up by private educational institutions, such as companies specializing in providing online courses for children (@melscience). In contrast to the individual accounts, institutional accounts create content based on a more conventional one-way teaching style, which often features one person delivering a miniature lecture in a TikTok video. In terms of both followers and average engagement rate, organizational science accounts outperform the other account creator categories (for all the engagement metrics, see Table 2).

The science-themed aggregator accounts (*N* = 7) do not explicitly represent individuals or organizations; they are used to curate and further disseminate science-themed content. Examples of this type of account are @_powervision_ and @seeker. On average, each aggregator profile contributed 32 videos, making them the most prolific creators of science-related videos (Figure 7). Nevertheless, user engagement was much lower for these types account creators than for the other types of creators.

Nonscience-themed accounts had a lower average engagement rate than the science-themed profiles. However, almost all the most popular videos in our data set were produced by these accounts. Thus, although science-themed accounts are more popular, on average, they are not one of the most viral "outliers."

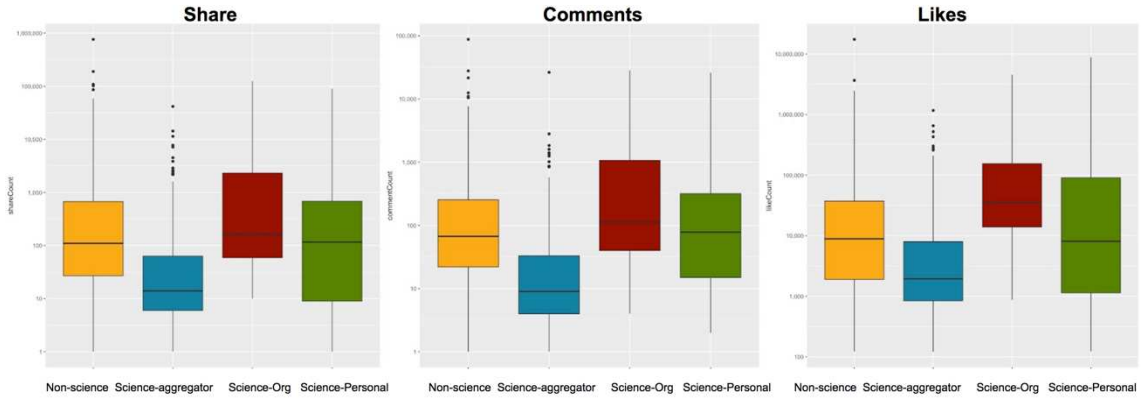

Figure 7. Boxplots of three engagement metrics of videos from four creator groups: nonscience-themed actors (yellow), science aggregators (blue), science organization (red), and science personal accounts (green).

Which Vernacular Styles Can Be Distinguished Among the Science Memes?

Based on the qualitative analyses, we distinguished three types of vernacular styles that can be found among the science memes on TikTok.

Affective Science

We define affective science memes as memetic content that uses science to convey relatable and phatic messages. In these memes, science or scientific knowledge is not the central theme; rather, it is used as an affective device for relatable storytelling, emotive expression, and social connection (Katz & Shifman, 2017; Miltner & Highfield, 2017). The previously mentioned "soap and pepper" experiment is a case in point (Figure 8). In this experiment, black pepper is sprinkled in a container with water. When one touches the water with a finger covered in detergent, the floating pepper is suddenly repelled because of the disturbed surface tension. What made this common experiment viral on TikTok was not the science behind it, but how it was deployed in the service of affective storytelling. In the most viral version of this experiment, a female TikToker uses the pepper's response as a metaphor for how, in reality, she (the finger) repels boys in the world (pepper flakes) whenever she approaches them. This video, together with the background narrative, attracted more than 24,000 re-creations on TikTok. In affective science memes, science may appear as a nonsensical element, but it is loaded with affective meaning, which allows the creators/re-creators to express themselves, "but also negotiate their affiliation to meme culture, demonstrating that they are attuned to earlier nonsensical forms and to the people generating them" (Katz & Shifman, 2017, p. 837). The platform logic of TikTok centers on trends and meme creation, so being attuned to and imitating memes for the sake of imitating is part and parcel of being *TikTok scientists*.

Figure 8. Examples of the viral soap and pepper experiment on TikTok.

Aesthetic Science

A second category of science memes presented science phenomena or science objects in a way that emphasized their aesthetic quality. We call this practice "aesthetic science," employing a broad understanding of aesthetics and defining it as a hedonic response to a sensory experience that can be both pleasant and unpleasant visually (Shimamura & Palmer, 2012). Most content in this category focuses on the soothing, satisfying visual nature of the video. These videos do not directly convey scientific knowledge or facts; they showcase the beauty of scientific phenomena or the natural world (Figure 9). Examples include footage shot through microscopes, capturing chemical reactions in slow motion, or videos presenting time-lapse images of colorful marine life.

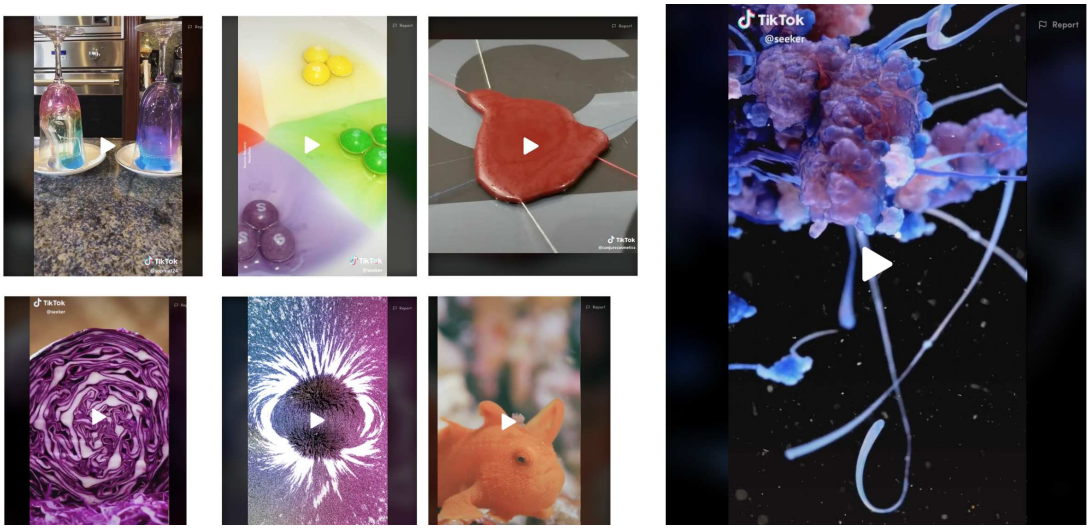

Figure 9. Examples of #satisfying science videos.

Not all aesthetic science memes present "mainstream beauty," and some of them could be perceived as unconventional or irritating. This second type of aesthetic science caters to a niche meme community with a different logic of aesthetic pleasure (Schonig, 2020). The videos from the Institute of Human Anatomy (@instituteofhumananatomy), a United States-based research and training facility, are a case in point. Its TikTok profile has over 5 million followers, and it has contributed numerous viral videos to our data set. For instance, Figure 10 shows an educational video demonstrating the human stomach; this video was viewed more than 13 million times and attracted over 200 duets.

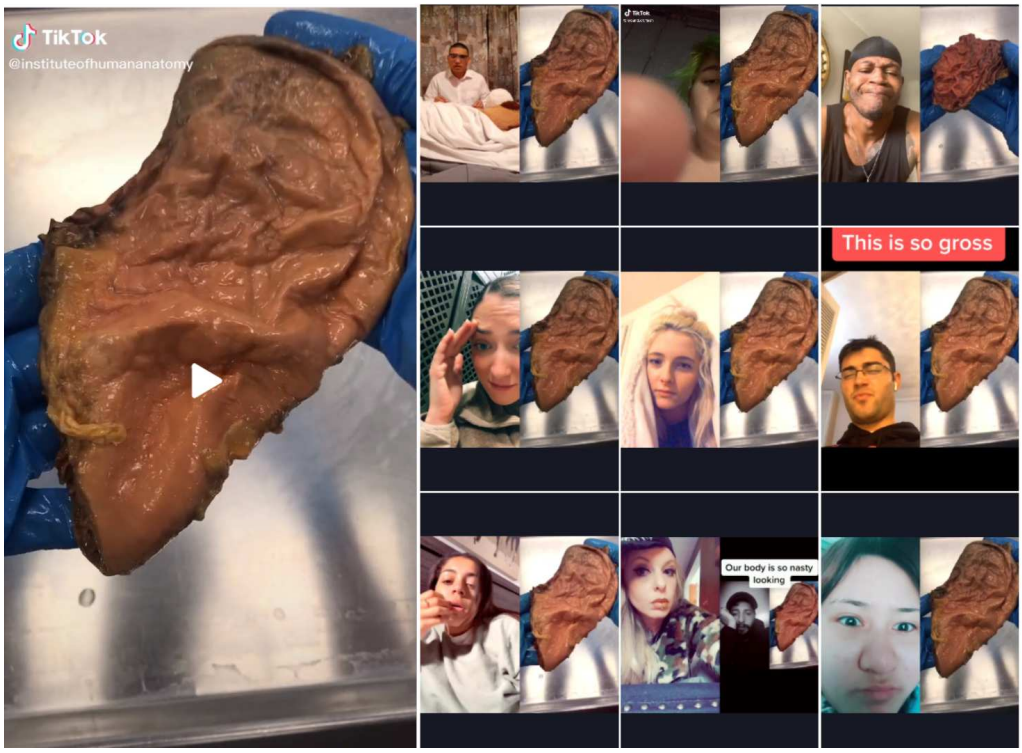

Figure 10. Example of a video from @instituteofhumananatomy and its duets.

Mycologist Dr. Gordon Walker's videos of wolf's milk slime mold being popped is another example (Figure 11). In the #oddlysatisfying clip, the creator pokes open the cyst-like slime mold. Although in a different video, Dr. Gordon also explains that they are not fungi, but protists—single-celled amoeba-like organisms—what makes videos of slime mold popular is the gratifying nature of watching them pop (Swannell, 2016; Zaccarini, 2018).

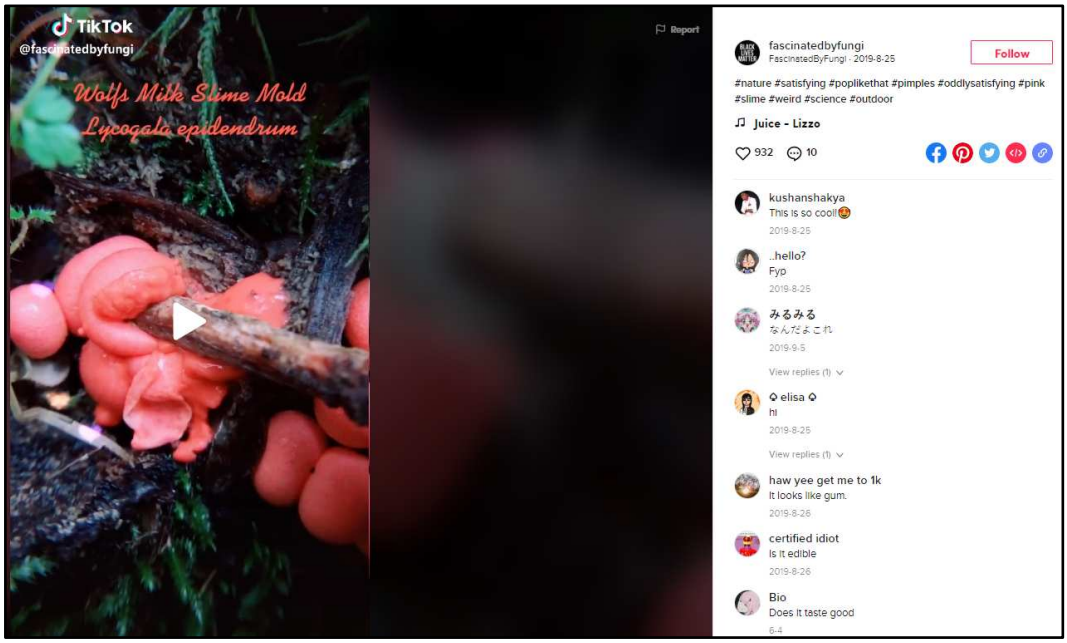

Figure 11. Example of Dr. Gordon's slime mold videos.

Nerdy Is the New Trendy

Not all vernacular science memes are embellished with catchy soundtracks, dance moves, or flamboyant visual effects. We found a third style of science meme that simply showed TikTokers discussing/sharing science facts in a casual setting, such as in bathrooms (Figure 12).

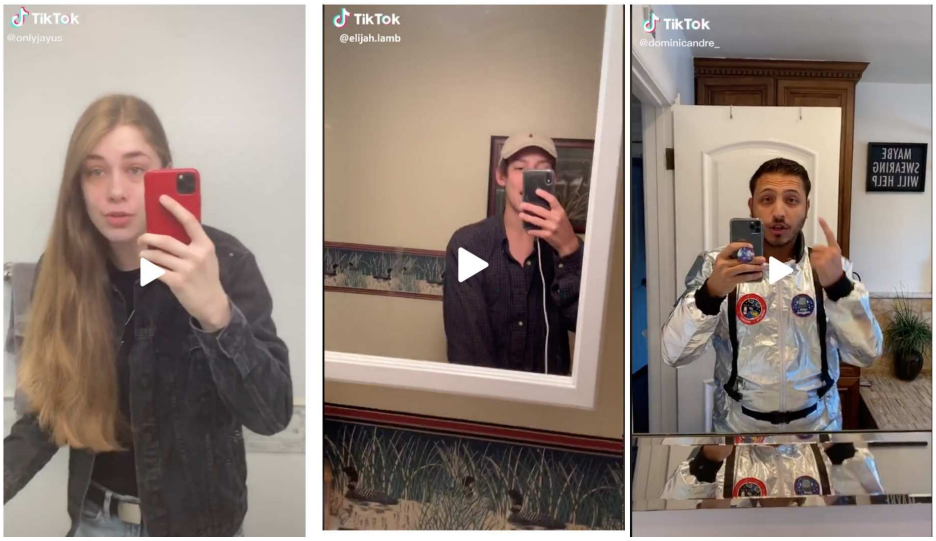

Figure 12. Examples of #didyouknow fact-sharing videos.

While the previously mentioned vernacular styles celebrate the affective meaning and visuality of science memes, this unadorned style becomes viral by imparting scientific knowledge. These memes mostly focus on science facts that are fun, surprising, or weird. For instance, the most successful TikToker of this genre is 21-year-old Isabella Avila (@onlyjayus), with 7.8 million followers (May 2020; Figure 13). She talks about "trivial" science facts, including "how to tell if someone has a crush on you," "really weird human body facts that I can guarantee you did not know," and "what your birth month actually says about you."

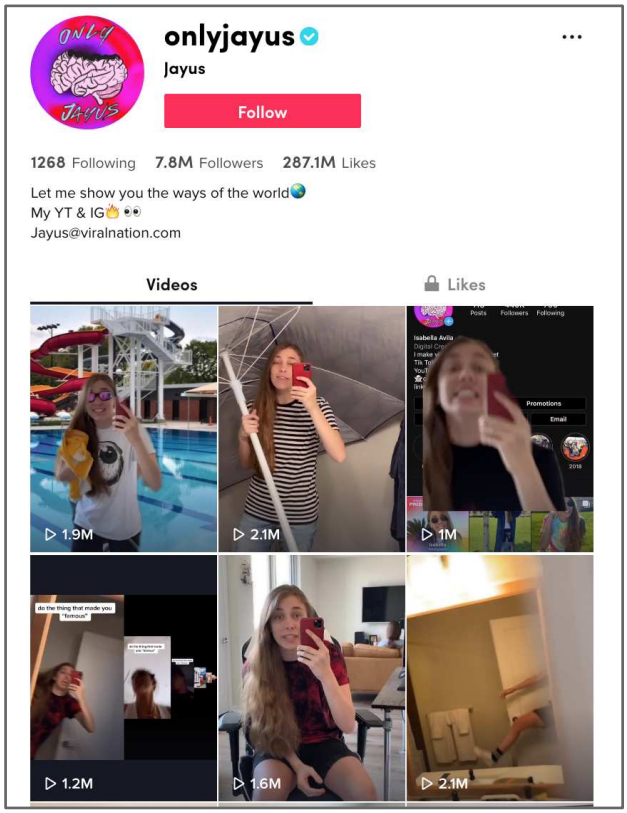

Figure 13. A screenshot of Isabella Avila's profile.

Compared with other TikTok memes, such fact-sharing videos are more cost-effective because they require less work to edit, filter, choreograph, and add music. However, when the videos rely solely on the information's shocking and/or entertaining impact to achieve popularity, it is not surprising that some creators use the format to spread pseudoscience. For instance, an article from the *Daily Mail* stating that testicles have taste receptors was widely circulated on TikTok and led a large number of male TikTokers to dip their testicles into soy sauce to test the theory. This trend went viral on TikTok and was soon given the moniker #soysaucechallenge. However, the seemingly harmless experiment escalated. In one instance, a TikToker claimed he injected soy sauce into his testicles "for science" (Figure 14). Although it is unlikely that he did what he claimed, the example demonstrates the lengths that certain creators are willing to go to in order to attract notoriety.

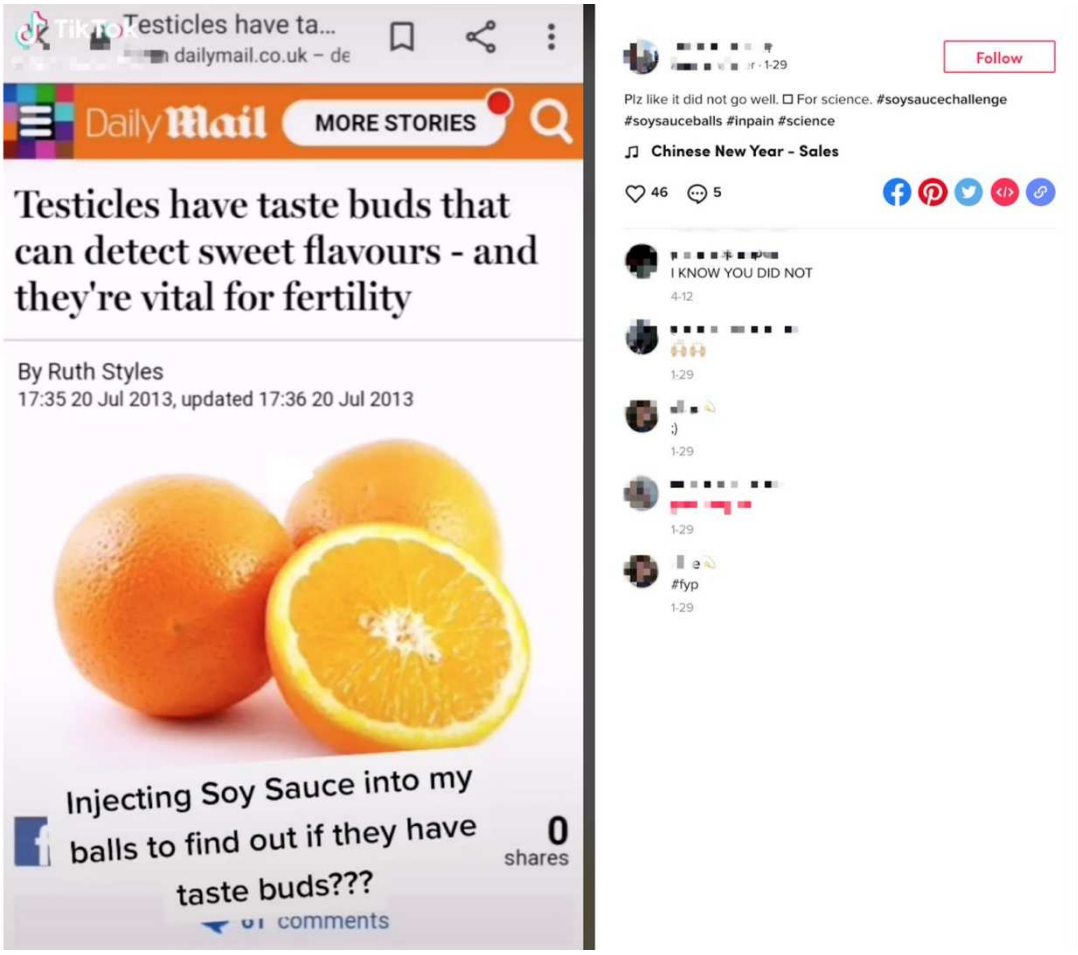

Figure 14. An example video of the #soysaucechallenge.

In January 2019, a TikToker uploaded a video revealing that there was a "mysterious" tablet inside pregnancy tests. This video triggered numerous viral response videos, with some TikTokers claiming that the moisture-absorbing table was a "Plan B" birth control pill (Figure 15), and some even swallowed (or pretended to swallow) the tablet in their videos. Another recent example of a potentially dangerous video was the claim that users could get high by eating large quantities of nutmeg; this also evolved into a TikTok challenge with participants recording their reactions to eating large doses of the spice.

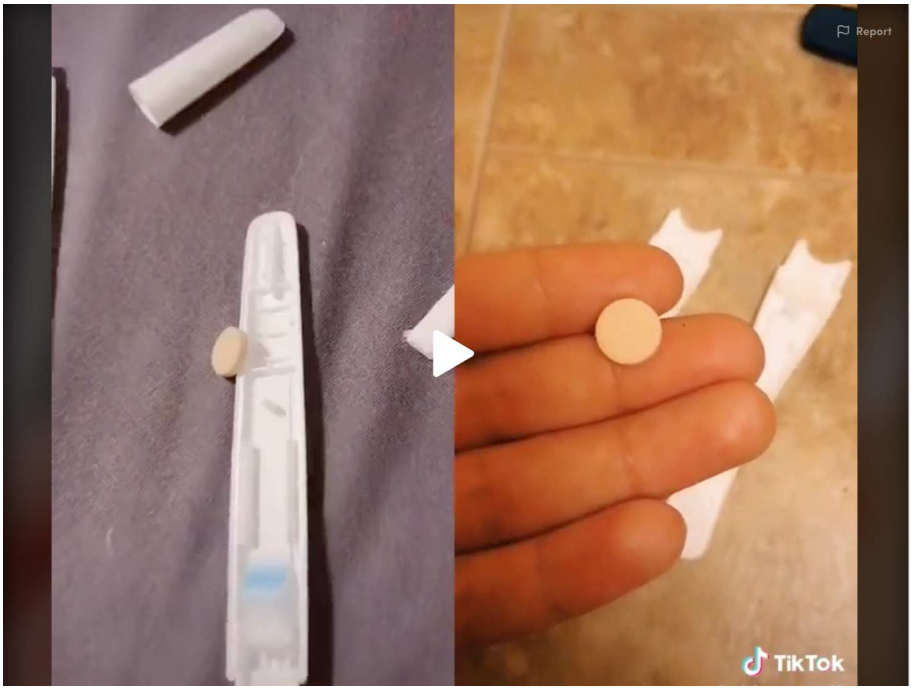

Figure 15. An example video of the pregnancy-test memes.

Discussion and Conclusion

With TikTok's rising popularity, the prevalence of science-related content has increased, and it will continue to grow. From its 2019 #eduTok to the COVID-triggered #scienceathome and #learnontiktok campaigns (Thoensen, 2020), TikTok is pushing its image as a platform for entertainment and educational content. Our study investigated the characteristics and sources as well as the vernacular repertoires of science meme videos on TikTok.

The combination of qualitative and quantitative content analysis of meme videos revealed that the presence of science on TikTok is dominated by entertaining physics or chemistry experiments. On the one hand, this strong representation of STEM sciences and experimental settings is consistent with prior studies on the science coverage of legacy media, which also focuses on STEM subjects presented by scientists and other elite voices (Elmer, Badenschier, & Wormer, 2008; M. S. Schäfer, 2012; Summ & Volpers, 2016); moreover, it corresponds to the public's common understanding of what science is (Koch, Saner, Schäfer, Herrmann-Giovanelli, & Metag, 2020). Our results indicate that TikTok does not broaden the spectrum of scientific disciplines that are presented to, or thought about by, the public. However, the strong focus of TikTok videos on the procedural aspects of scientific experiments is interesting. The majority of the memes present the process through which experiments are conducted, thereby complying with a long-standing demand in science communication to focus on science in the making (Shapin, 1992)—a demand that legacy media often fail to achieve.

The results further demonstrate that TikTok memes present science as an individual rather than a collective enterprise. Evidence from the scholarly literature suggests that such uncritical personalization of science communication is also pronounced in legacy media, where personalization—that is, the strong concentration of coverage on prominent individuals instead of scientific teams, organizations, or the system of science—has important news value for science-related content (Badenschier & Wormer, 2012). On TikTok, the personalization of science communication works in two ways. First, science is communicated as memetic content mostly by individual TikTokers, including a number of science-themed TikTok stars. Second, science and science practitioners are also personalized in the sense that they are presented as approachable and relatable. As seen in the example of science practitioners demonstrating their behind-the-scenes life, such content has its own significance. For instance, using self-presentation, scientists counteract the negative stereotypes associated with their profession. By de-mythicizing science, or by showing that practicing science requires diligence but is also fun, scientists promote and legitimize a more realistic image of science (Allgaier, 2013). Another important finding from the creator analysis is that the science institutional accounts perform better in producing engaging content than do the other types of accounts (as indicated by the likes and comments counts). This result indicates the potential of TikTok to be used by educational institutions to reach out to their target (young) audience.

This study also investigated the peculiarity of TikTok memes as a mediator to present science, especially in comparison with existing models of science communication. We summarized these novel characteristics into three vernacular styles: affective science, aesthetic science, and nerdy is the new trendy. These memetic styles provide unique material to understand how popular digital culture, especially meme-centered media practice, shapes the way science is imagined and communicated by and to young people. Effectively communicating science on short video platforms requires the content creators to place greater emphasis on the visuality of the content. Aesthetic science memes are a good case in point. However, as demonstrated in our example of popping memes, in addition to beautiful or soothing science content, visually shocking or irritating videos also demonstrate mimetic values. It is worth mentioning that this genre of "popping science" has a long history on the Internet. Medical dermatologists post YouTube videos of themselves conducting various forms of "skin pops," catering to a niche community that finds these videos satisfying and even relaxing (Swannell, 2016; Zaccarini, 2018).

The communicative style of TikTok memes also requires affective storytelling. As demonstrated in the case of affective science, the *affective meanin*g of video content is as important as its *scientific meaning*. An example of science memes in the affective science category demonstrates that one way to achieve affective meaning is through what Abidin (2017) called *calibrated amateurism*—the practice in which creative labors deliberately craft "authenticity that portrays the raw aesthetic of an amateur, whether or not they really are amateurs by status or practice, by relying on the performance ecology of appropriate platforms, affordances, tools, cultural vernacular, and social capital" (p. 1). In science memes, calibrated amateurism can be exemplified by the common usage of kitchenware, food, and other everyday products in science demonstrations on TikTok. This form of affective storytelling may challenge the conventional norms in science communication, as precision is replaced by casualness and accessibility is celebrated over authoritativeness.

Moreover, the trendy factor in science content, as indicated in the nerdy-is-the-new-trendy meme style, boosts the production of videos presenting science as entertaining activities with an engaging impetus, explicitly or implicitly, motivating users to recreate the content. In the case of science experiments, a regularly featured theme, the process of meme re-creation requires self-teaching and researching. As previously mentioned, "science magics" are often presented in a short video format with little verbal explanation. However, to recreate and reinvent this type of memetic content, TikTokers have to conduct their own research. This process of remixing through self-teaching represents a special form of dialogue among TikTokers. Rather than a one-way model of top-down knowledge transmission or superficial exchanges between scientists and the public, science memes are characterized by self-initiated and peer-based communal learning processes.

The findings from our study enrich the science communication scholarship in the new digital media context; they also provide pragmatic insights into how educators/scientists can better communicate science to a younger audience. As previously mentioned, TikTok is increasingly promoting science-related campaigns on the platform, and this trend inevitably attracts more TikTokers to integrate more "science" into their content creation. Although this wider participation in science-content creation is a positive trend, as a form of science communication, TikTok has its limitations.

First, while that the wow-factor of science that is emphasized in TikTok memes may trigger the interest of youth, it demonstrates an excessively uncritical attitude toward science. In earlier research, the science content in print media was described as the "miracle pages" (M. S. Schäfer, 2011) where science is presented as "an arcane and incomprehensible subject" (Nelkin, 1991, p. 14). Although this noncritical approach to science communication can be counterproductive to the improvement of science (Kuhn, 2012), it remains prominent in the context of science memes on TikTok.

Second, in addition to genuine scientific content, pseudoscience and science trolls flourish on TikTok. As demonstrated in the example of TikTok challenges with pregnancy tests and nutmeg, TikTokers' fanaticism for memetic "science" content can have detrimental consequences. Regarding viral TikTok videos, the line between teaching and joking/trolling is so ambiguous that content verification remains crucial and challenging. However, despite its enthusiasm to promote science, TikTok should exert greater effort to combat pseudoscience and science trolls that take advantage of the platform's promotion of science-tagged content. While we were writing this article, TikTok has reportedly been rolling out new anti-misinformation campaigns on its platform (Sullivan, 2020). However, as this study has shown, when facts, jokes, trolls, and pranks are integrated into a single entity to achieve virality, it is extremely challenging to manage false information in video memes.

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